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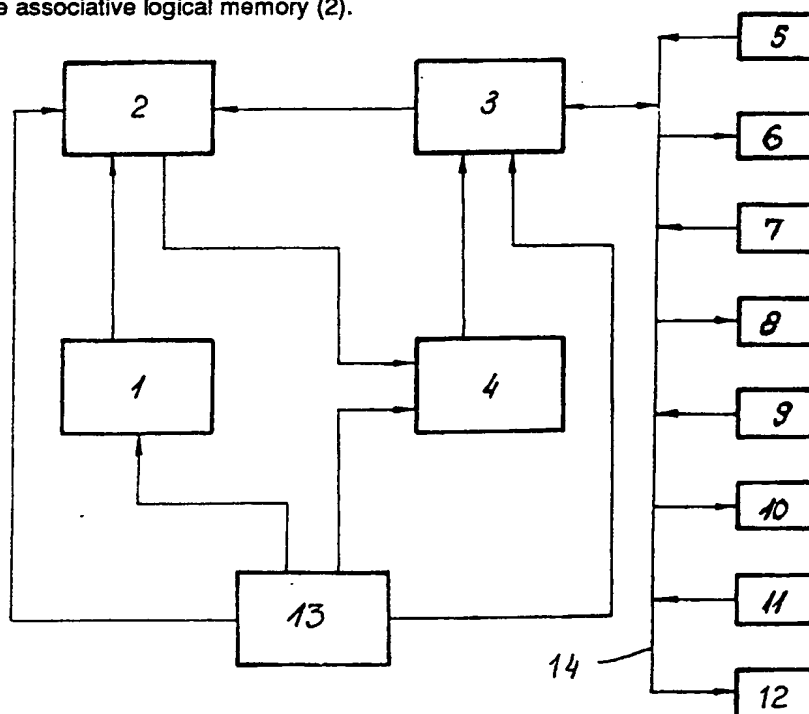
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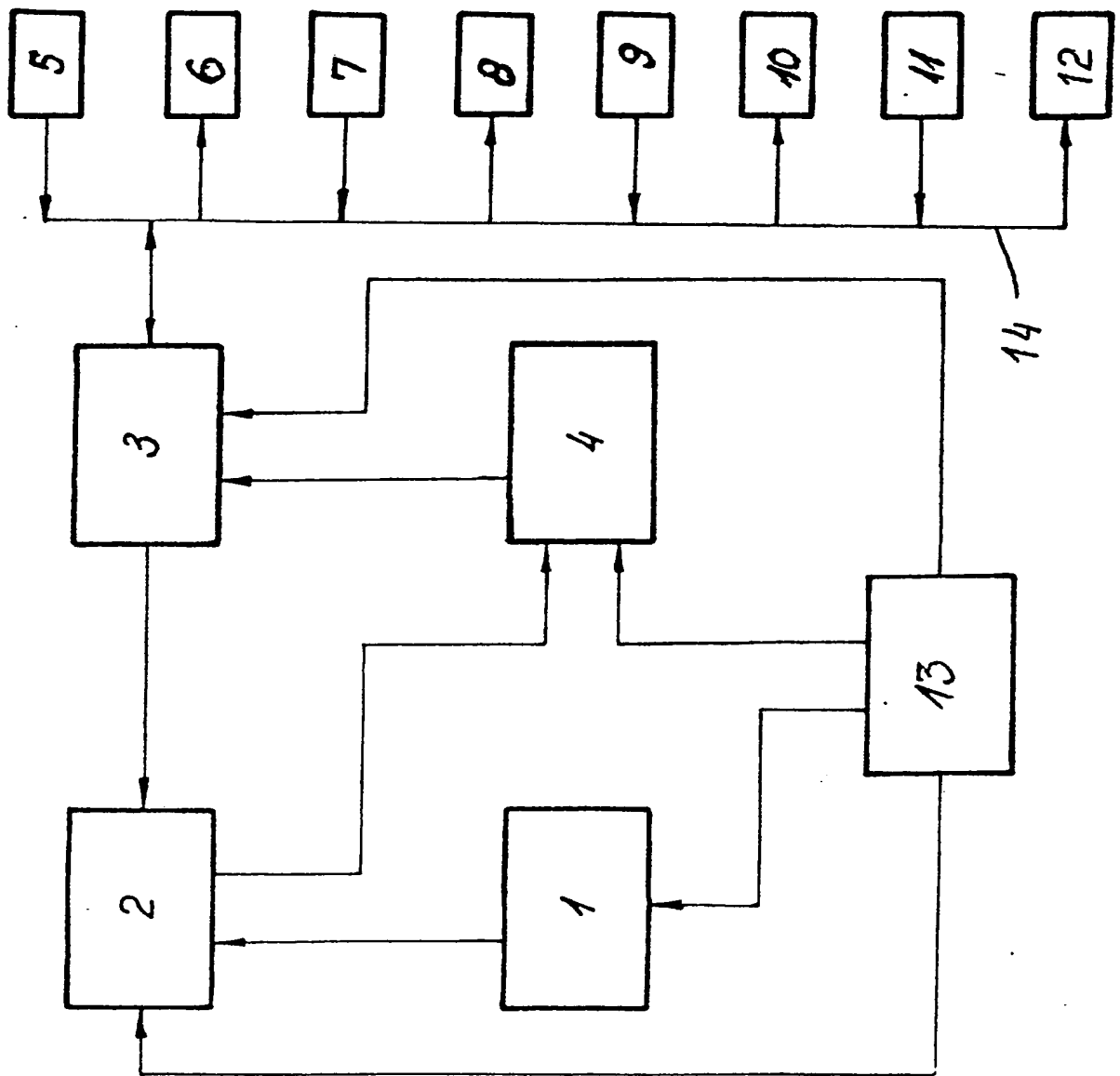
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(54) **Knowledge processing system**

(57) The knowledge processing system is applicable to artificial intelligence systems for solving unformal problems, i.e. problems in a rule-based form rather than a purely mathematical form. The system includes an associative logical memory (2) storing a knowledge base, which can produce a result at its outputs when presented with query data at its inputs. Input means (3, 4) connect the associative logical memory to external devices, which can include speech and image recognition units (6, 8), a speech synthesizer (5) and/or visual display unit (7), and so forth. A knowledge interpreter (1) used during setting up of the system, to translate data entered for the knowledge base into a rule-based form suitable storage in the associative logical memory (2).



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KNOWLEDGE PROCESSING SYSTEM

This invention relates to a knowledge processing system, which is applicable to artificial intelligence for solving unformal problems through expert systems
5 technology.

A knowledge processing system is known which includes a data input connected via an input register to an input processor; the input processor is connected by means of two-way buses to an instruction memory, to
10 a main memory and to a mass storage device; and its output is connected via an output register to an output device.

A disadvantage of this known circuit is its lack of capability for quick and effective solving of
15 unformal problems. Unformal problems are problems represented not in a formal way as formulae or algorithms, but rather as production rules e.g. of the form: "if (condition) then (conclusion)", where (condition) is a logical combination of facts,
20 variables and so forth and (conclusion) is an action to be taken.

Because of low utilization of the elements in the known circuit's classical architecture and the reduced reliability of logical processing (inference), which
25 restricts its range of application, the known circuit cannot deal with problems in such a form .

It is therefore desirable to provide an electronic circuit for knowledge processing having increased
reliability, effectiveness and speed for realizing
30 logical inferences, as well as an extended range of application.

According to the present invention, there is provided a knowledge processing system comprising an associative logical memory storing a knowledge base in
35 a rule-based form and operable to supply a result in

response to data supplied to it constituting a query;

input-output means arranged to supply data to the associative logical memory and to receive data from the associative logical memory, and operable to exchange

5 data with external devices;

and a knowledge interpreter operable to cause the associative logical memory to store data initially supplied to it in said rule-based form so as to establish the knowledge base.

10 The system preferably further comprises a clock for synchronizing operation of the associative logical memory, the input-output means, and the knowledge interpreter.

The input-output means preferably comprises an
15 input-output converter having an output connected to an input of the associative logical memory and connected to external devices via a bus, and an output block having an input connected to an output of the associative logical memory, and an output connected to
20 an input of the input/output converter.

Advantageously, the system further includes, as an external device, a speech recognition unit for entry of data into the knowledge base.

The system may further include, instead or in
25 addition, an image recognition unit for entry of data into the knowledge base.

Furthermore, the system advantageously includes, as an external device, a speech synthesizer and/or a visual display unit for output of results from the
30 associative logical memory.

As further external devices, at least one monotype circuit and/or communications link may be provided.

The knowledge interpreter may take the form of a permanent memory storing information for formatting
35 entered data in said rule-based form.

Advantages of a knowledge processing system

embodying the invention, are universal applicability to solving arbitrary unformal problems, including operation in real time, increased reliability, effectiveness and speed of realization of logical inferences. An integrated (IC) implementation of the system is possible.

Reference will now be made, by way of example, to the accompanying drawing which is a block diagram of a preferred embodiment of the invention.

10 In the system, as shown in the drawing, the outputs of a knowledge interpreter 1 are connected to inputs of an associative logical memory 2. Another group of inputs of the associative logical memory 2 is connected to an input/output converter (interface) 3, and its outputs are connected to the inputs of an output block 4 which is built as a circuit of logical and digital comparing elements, and whose outputs are connected to the inputs of the input/output converter 3. The input/output converter 3 is connected by means of a two-way connection (bus) 14 with external devices - a speech synthesizer 5, a speech recognition device 6, a visual display output unit (VDU) 7, an image recognition unit 8, a communications link 9 and 10 and monotype (similar) circuits for data processing 11,12, (possibly a keyboard) which are provided as appropriate depending on the particular application field. Clock inputs for synchronizing the operation of the knowledge interpreter 1, associative logical memory 2, input/output converter 3 and output block 4 are connected respectively to the outputs of a clock 13.

A data base of knowledge and facts (knowledge base) is stored in the associative logical memory 2, using the knowledge interpreter 1, such that when one item of data ("query") is presented at the inputs of the memory, this has the effect of reading out other data ("result") from the memory which is sent to the

output block 4.

The knowledge interpreter contains language (format) data for storing or presenting the stored knowledge in a particular language, in the form of production rules. That is, the knowledge interpreter is a permanent memory for recording the entered knowledge from the input/output transformer 3 in a rule-based format suitable for storage in the associative logical memory 2 and for processing in the output block 4. The knowledge interpreter is not used in normal operation of the system after it has been finalised.

The setting-up and operation of the knowledge processing system are as follows.

The knowledge base is entered into the system through the external devices - the speech recognition unit 6, the image recognition unit 8, the communications link 10 or one of the data processing circuits e.g. 12, by means of the two-way connection to the input/output converter 3. The knowledge base is then written into the associative logical memory 2 after a transfer under control of the interpreter 1 in the language (rule-based format) for presenting the knowledge.

Using the entered knowledge base, the output block 4 realizes in synchronization under the control of the synchronizing signals from the clock 13, logical output, whose result is led out through the input/output converter 3 and the two-way connection to the external devices - the speech synthesizer 5, the VDU 7, the communications link 9 and the data processing circuit 11.

In the set-up mode of the system, the knowledge base for a concrete application is written in the associative logical memory 2 after transformation and transfer under the control of the interpreter 1 in the

language for presenting knowledge.

In the expert control mode (normal operation mode) of the system, the knowledge base is interrogated by entering knowledge or facts using the respective
5 external devices, and a logical output is obtained from the output block 4, whose conclusion is led out for utilization of the use of the system. For example, query data is entered by speaking into a microphone, and the speech signal is decoded into text form data by
10 the speech recognition unit 6. The unit 6 sends the query data via the bus 14 to the interface 3, which in turn presents the data to the inputs of the associative logical memory 2. This causes result data to be read out from the associative logical memory 2, which is
15 sent via the output block 4 to the interface 3 and placed on the bus 14. The result is received by the VDU 7 to be displayed in the form of text, and/or it is received by the speech synthesizer 5 to be output in the form of speech.

20 Thus, as explained above, the knowledge processing system is applicable to artificial intelligence systems for solving unformal problems, i.e. problems in a rule-based form rather than a purely mathematical form. The system includes an associative logical memory storing a
25 knowledge base, which can produce a result at its outputs when presented with query data at its inputs. Input/output means connect the associative logical memory to external devices, which can include speech and image recognition units, a speech synthesizer
30 and/or visual display unit, and so forth. A knowledge interpreter is used during setting up of the system, to translate data entered for the knowledge base into a rule-based form suitable for storage in the associative logical memory.

CLAIMS:

1. A knowledge processing system comprising:-
an associative logical memory storing a
knowledge base in a rule-based form and operable to
5 supply a result in response to data supplied to it
constituting a query;
input-output means arranged to supply data to
the associative logical memory and to receive data from
the associative logical memory, and operable to
10 exchange data with external devices;
and a knowledge interpreter operable to cause
the associative logical memory to store data initially
supplied to it in said rule-based form so as to
establish the knowledge base.
- 15 2. A knowledge processing system as claimed in
claim 1, further comprising a clock for synchronizing
operation of the associative logical memory, the input-
output means, and the knowledge interpreter.
- 20 3. A knowledge processing system as claimed in
claim 1 or 2, wherein the input-output means comprises:
an input/output converter having an output
connected to an input of the associative logical memory
and connected to said external devices via a bus; and
an output block having an input connected to
25 an output of the associative logical memory, and an
output connected to an input of the input/output
converter.
- 30 4. A knowledge processing system as claimed in
claim 1, 2 or 3, wherein the system further includes,
as a said external device, a speech recognition unit
for entry of data into the knowledge base.
- 35 5. A knowledge processing system as claimed in
any preceding claim, wherein the system further
includes, as a said external device, an image
recognition unit for entry of data into the knowledge
base.

6. A knowledge processing system as claimed in any preceding claim, wherein the system further includes, as a said external device, a speech synthesizer for output of results from the associative
5 logical memory.

7. A knowledge processing system as claimed in any preceding claim, wherein the system further includes, as a said external device, a visual display unit for output of results from the associative logical
10 memory.

8. A knowledge processing system as claimed in any preceding claim, wherein the system further includes, as a said external device, at least one monotype circuit.

15 9. A knowledge processing system as claimed in any preceding claim, wherein the system further includes, as a said external device, a communications link.

20 10. A knowledge processing system as claimed in any preceding claim, wherein the knowledge interpreter is in the form of a permanent memory storing information for formatting entered data in said rule-based form.

25 11. A knowledge processing system substantially as hereinbefore described with reference to the accompanying drawing.